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FEBRUARY 2007

REPORT NO. 06-24

TRANSPORTABILITY TESTING OF THE ENGINEER EQUIPMENT TRAILER (EET), TP-94-01, "TRANSPORTABILITY TESTING PROCEDURES"

Prepared for:

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TRANSPORTABILITY TESTING OF THE ENGINEER EQUIPMENT TRAILER, TP-94-01, REV. 2, JUNE 2004, "TRANSPORTABILITY TESTING PROCEDURES"

ABSTRACT

The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SJMAC-DEV), was tasked by the Program Manager – Engineer Systems, Marine Corps Systems Command to conduct transportability testing on the Engineer Equipment Trailer (EET). The EET was manufactured by TEREX/Load King, Elk Point, SD. The testing was conducted in accordance with TP-94-01, Revision 2, June 2004, "Transportability Testing Procedures."

The objective of the testing was to evaluate the EET, when transportability tested in accordance with TP-94-01, Revision 2, June 2004.

The tie-down rings and anchors on the EET performed adequately during testing. The utilized test loads were effectively and efficiently secured using the tie-down provisions. The trailer, as currently designed, is adequate for the transport of bulk ammunition forward of the deck plates and not overloading the lunette.

However, the trailer, as designed, **cannot transport a full 10-ton payload** of ammunition. The ammunition loads were secured forward of the deck plates and limited to 4,900 pounds (120MM Tank Ammunition) and 5,460 pounds (155MM Separate Loading Projectiles), to prevent overloading of the trailer lunette.

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PART 1 – INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SJMAC-DEV), was tasked by the Program Manager - Engineer Systems, Marine Corps Systems Command to conduct transportability testing on the Engineer Equipment Trailer (EET). The EET was manufactured by TEREX/Load King, Elk City, SD. The testing was conducted in accordance with TP-94-01, Revision 2, June 2004, "Transportability Testing Procedures."

B. AUTHORITY. This test was conducted IAW mission responsibilities delegated by the U.S. Army Joint Munitions Command (JMC), Rock Island, IL. Reference is made to the following:

1. AR 740-1, 15 June 2001, Storage and Supply Activity Operation.

2. OSC-R, 10-23, Mission and Major Functions of U.S. Army Defense Ammunition Center (DAC) 21 Nov 2000.

C. OBJECTIVE. The objective of the testing was to evaluate the EET, when transportability tested in accordance with TP-94-01, Revision 2, June 2004.

D. CONCLUSION. The tie-down rings and anchors on the EET performed adequately during testing. The utilized test loads were effectively and efficiently secured using the tie-down provisions. The trailer, as currently designed, is adequate for the transport of bulk ammunition forward of the deck plates and not overloading the lunette.

However, the trailer, as designed, **cannot transport a full 10-ton payload** of ammunition. The ammunition loads were secured forward of the deck plates and limited to 4,900 pounds (120MM Tank Ammunition) and 5,460 pounds (155MM Separate Loading Projectiles), to prevent overloading of the trailer lunette.

PART 2 - ATTENDEES

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PART 3 - TEST EQUIPMENT

1. Trailer, EET

   Manufactured by: TEREX/Load King, Elk City, SD

   Manufacture Date: 7/2006

   VIN: 5LKT3121261026281

   Model No: M322LT

   Rated Frame Capacity: 20,000 pounds

2. Truck, Cargo, 7-ton w/o Winch

   Manufactured by: Oshkosh Truck Corporation, Oshkosh, WI

   Date of Manufacture: 3/2002

   Model No: MK23

   Serial No: 072917

   Vehicle ID: 10TDMWE362S072917

   Max Cargo: 30,000 pounds

   Max Trailer: 22,000

PART 4 - TEST PROCEDURES

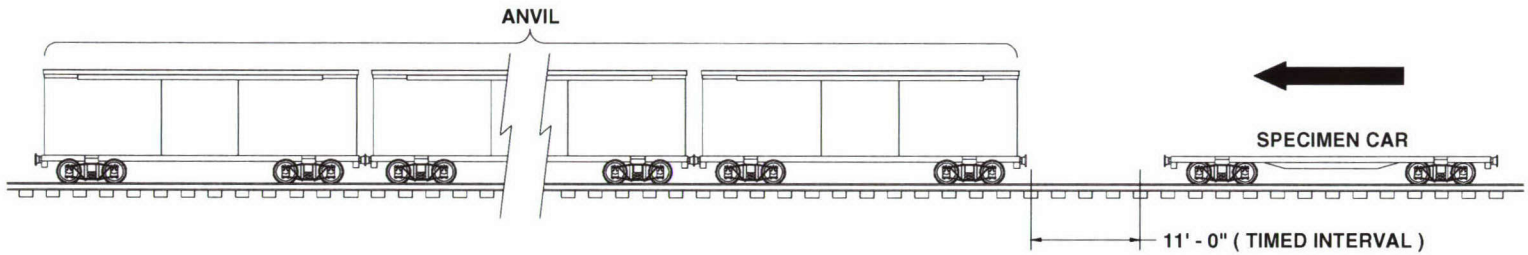
The test procedures outlined in this section were extracted from TP-94-01, "Transportability Testing Procedures," Revision 2, June 2004, for validating tactical vehicles and outloading procedures used for shipping munitions by tactical truck, railcar, and ocean-going vessel.

Inert (non-explosive) items were used to build the load. The test loads were prepared using the blocking and bracing procedures proposed for use with munitions (***see Part 6 for procedures***). The weight and physical characteristics (weights, physical dimensions, center of gravity, etc.) of the test loads were similar to live (explosive) ammunition. The following tests identified are normally required for transportability certification. However, not all tests will be required for some specific items.

A. RAIL TEST. RAIL IMPACT TEST METHOD. The test load or vehicle will be secured to a flatcar. The equipment needed to perform the test will include the specimen (hammer) car, four empty railroad cars connected together to serve as the anvil, and a railroad locomotive. The anvil cars will be positioned on a level section of track with air and hand brakes set and with draft gears compressed. The locomotive unit will push the specimen car toward the anvil at a predetermined speed, then disconnect from the specimen car approximately 50 yards away from the anvil cars allowing the specimen car to roll freely along the track until it strikes the anvil. This will constitute an impact. Impacting will be accomplished at speeds of 4, 6, and 8.1 mph in one direction and at a speed of 8.1 mph in the reverse direction. The tolerance for the speeds is plus 0.5 mph, minus 0.5 mph for the 4 mph and 6 mph impacts, and plus 0.5 mph, minus 0 mph for the 8.1 mph impacts. The impact speeds will be determined by using an electronic counter to measure the time for the specimen car to traverse an 11-foot distance immediately prior to contact with the anvil cars (see Figure 1).

ASSOCIATION OF AMERICAN RAILROADS (AAR)

STANDARD TEST PLAN



4 BUFFER CARS (ANVIL)
WITH DRAFT GEAR COMPRESSED AND AIR BRAKES IN A SET POSITION

ANVIL CAR TOTAL WT. 250,000 LBS (APPROX)

SPECIMEN CAR IS RELEASED BY SWITCH ENGINE TO ATTAIN: IMPACT NO. 1 @ 4 MPH
IMPACT NO. 2 @ 6 MPH
IMPACT NO. 3 @ 8.1 MPH

THEN THE CAR IS REVERSED AND RELEASED BY SWITCH ENGINE TO ATTAIN:

IMPACT NO. 4 @ 8.1 MPH

Figure 1. Rail Impact Sketch

B. ON/OFF ROAD TEST.

1. **HAZARD COURSE**. The test load or vehicle will be transported over the 200-foot-long segment of concrete-paved road consisting of two series of railroad ties projecting 6 inches above the level of the road surface. The hazard course will be traversed two times (see Figure 2).

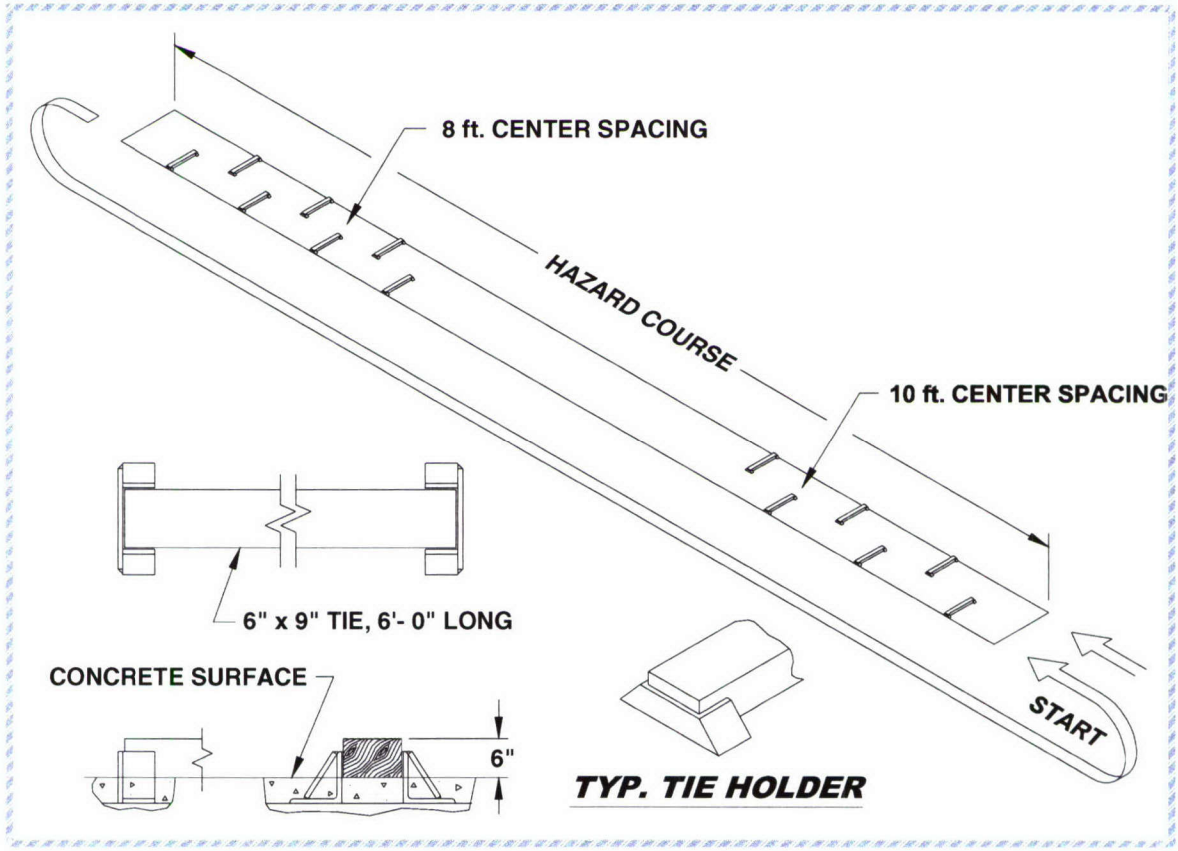


Figure 2. Hazard Course Sketch

a. The first series of 6 ties are spaced on 10-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 50 feet.

b. Following the first series of ties, a paved roadway of 75 feet separates the first and second series of railroad ties.

c. The second series of 7 ties are spaced on 8-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 48 feet.

d. The test load is driven across the hazard course at speeds that will produce the most violent vertical and side-to-side rolling reaction obtainable in traversing the hazard course (approximately 5 mph).

2. ROAD TRIP. The test load or vehicle will be transported for a distance of 30 miles over a combination of roads surfaced with gravel, concrete, and asphalt. The test route will include curves, corners, railroad crossings and stops and starts. The test load or vehicle will travel at the maximum speed for the particular road being traversed, except as limited by legal restrictions.

3. PANIC STOPS. During the road trip, the test load or vehicle will be subjected to three (3) full airbrake stops while traveling in the forward direction and one in the reverse direction while traveling down a 7 percent grade. The first three stops are at 5, 10, and 15 mph while the stop in the reverse direction is approximately 5 mph. This testing will not be required if the Rail Impact Test is performed.

4. WASHBOARD COURSE. The test load or vehicle will be driven over the washboard course (see Figure 3) at a speed that produces the most violent response in the vertical direction.

C. OCEAN-GOING VESSEL TEST. 80-DEGREE TILT TEST. The test load (specimen) shall be positioned on level terrain with the bottom corner fittings resting on timbers so the entire container is supported solely by the bottom corner fittings. The timbers shall be oriented parallel to the end rails of the container and extend 2 feet beyond the corner fittings on each side. Using two mobile cranes and appropriate rigging, the container shall be rotated (tilted) using the bottom corner fittings on one side as a fulcrum. The rigging (slings) of one crane shall be attached to the bottom corner fittings of the long side and the

rigging (slings) of the second crane shall be attached to the top corner fittings on the opposite side. The tilting shall be accomplished by lifting the bottom corner fittings with the first crane so the container rotates about the opposite bottom corner fittings (fulcrum). Lifting/rotating by the first crane is continued until the center of gravity passes over the fulcrum, at which point the second crane shall provide support to the container and lower the container to the 80 degrees, plus or minus 2 degrees position. Rotation shall be accomplished smoothly at a slow speed so the container sidewall is subjected only to the static force of the interior load. The crane booms shall be adjusted to maintain a rear vertical suspension of the rigging at all times. In the case of end-opening type containers, at least one door (lower side of tilted container) must be closed and fastened throughout the test. The container shall be held in the tilted position for a minimum of two minutes. At which time, observations of both the container structure and the interior load shall be made. When the test is completed, the container shall be returned to its upright position using the same manner and care in handling.

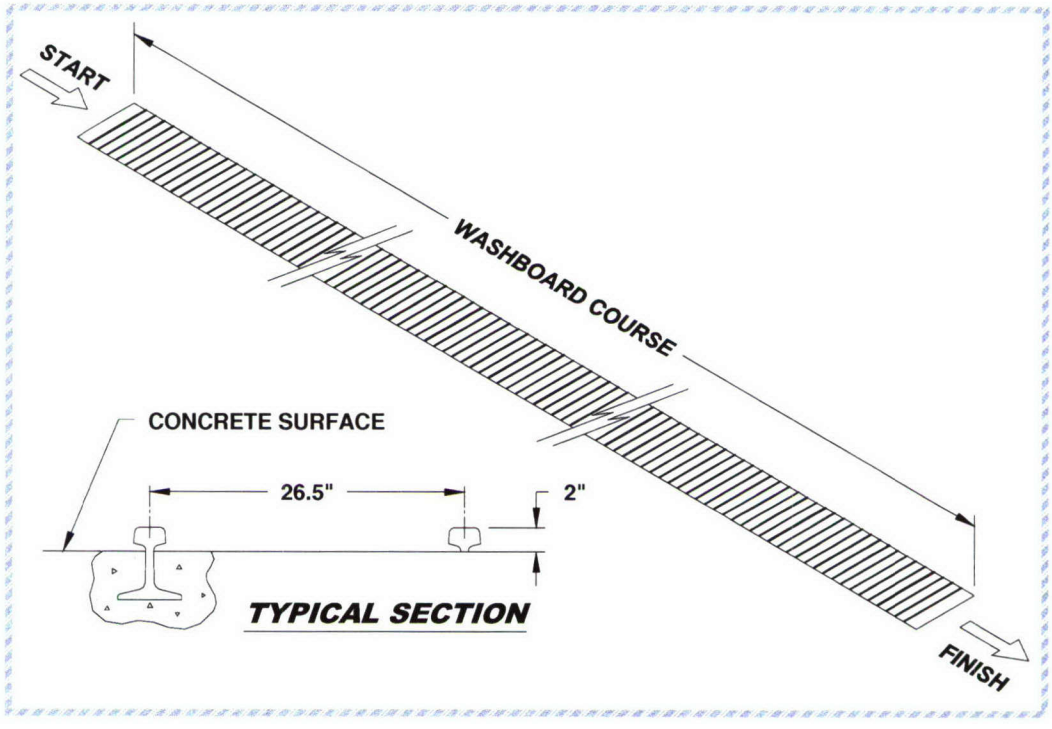


Figure 3. Washboard Course Sketch

PART 5 - TEST RESULTS

5.1

Testing Date: 14 December 2006

Test Specimen: Engineer Equipment Trailer (EET)

Payload: 155MM Separate Loading Projectiles (SLPs)

Test Gross Weight: 44,100 pounds (including the Medium Tactical Vehicle Replacement [MTVR], EET and 155MM SLPs)

Payload Weight: 5,460 pounds

Lunette Weight: 3,340 pounds

Note: Prior to the start of testing the front two twistlocks on the EET were removed. This was accomplished to prevent them from getting lost during testing. The front twistlocks were not secured in position; however, the rear twistlocks were secured in position. Removal is not required for the transport of ammunition.

A. ON/OFF ROAD TESTS.

1. HAZARD COURSE.

Photo 1. Hazard Course Testing of the EET with 155MM SLPs

Pass No.	Elapsed Time	Avg. Velocity (mph)
1	30 Seconds	5.1
2	30 Seconds	5.1

Figure 1.

Remarks:

1. Figure 1 lists the average speeds of the test load through the Hazard Course.
2. Inspection following Passes #1 and #2 revealed that the tie-down rings and anchors on the EET performed adequately.
3. Inspection following Passes #1 and #2 revealed that the payload did not move.

2. ROAD TRIP:

Remarks:

1. The Road Trip was conducted between the Road Hazard Course Passes #2 and #3.
2. Inspection following the completion of the Road Trip revealed that the tie-down rings and anchors performed adequately.

3. PANIC STOPS:

Remarks:

1. The Panic Stops were conducted during the Road Trip.
2. Following completion of the Panic Stops the strap was repositioned and retightened. Originally, the strap was too close to the pallet edge; and during testing, the strap repositioned itself and slid between the two pallets.
3. Inspection following the completion of the Panic Stops revealed that the tie-down rings and anchors performed adequately.

4. HAZARD COURSE:

Pass No.	Elapsed Time	Avg. Velocity (mph)
3	30 Seconds	5.1
4	30 Seconds	5.1

Figure 2.

Remarks:

1. Figure 2 lists the average speeds of the test load through the Hazard Course.
2. Inspection following Passes #3 and #4 revealed that the tie-down rings and anchors on the EET performed adequately.
3. Inspection following Passes #3 and #4 revealed that the payload did not move.

5. WASHBOARD COURSE:

Remarks:

1. Inspection following completion of the Washboard Course revealed that the tie-down rings and anchors on the EET performed adequately.
2. Inspection following completion of the Washboard Course revealed that the payload did not move.

Photo 2. Washboard Course Testing of the EET with 155MM SLPs

D. <u>CONCLUSION</u>: Throughout testing the tie-down rings and anchors on the EET performed adequately. The utilized test loads were effectively and efficiently secured using the tie-down provisions as designed. No damage occurred to the tie-down rings or anchors.

5.2

Testing Date: 14 December 2006

Test Specimen: Engineer Equipment Trailer (EET)

Payload: 120MM Tank Ammunition

Test Gross Weight: 43,540 pounds (including the Medium Tactical Vehicle Replacement [MTVR], EET and the 120MM Tank Ammunition)

Payload Weight: 4,900 pounds

Lunette Weight: 3,060 pounds

A. ON/OFF ROAD TESTS.

1. HAZARD COURSE.

Photo 3. Hazard Course Testing of the EET with 120MM Tank Ammunition

Pass No.	Elapsed Time	Avg. Velocity (mph)
1	30 Seconds	5.1
2	30 Seconds	5.1

Figure 3.

Remarks:

1. Figure 3 lists the average speeds of the test load through the Hazard Course.
2. Inspection following the completion of Pass #1 revealed that the payload moved toward the passenger side 0.5-0.75 inches.
3. Inspection following Passes #1 and #2 revealed that the tie-down rings and anchors on the EET performed adequately.

2. ROAD TRIP:

Remarks:

1. The Road Trip was conducted between the Road Hazard Course Passes #2 and #3.
2. Inspection following Passes #1 and #2 revealed that the tie-down rings and anchors on the EET performed adequately.

3. PANIC STOPS:

Remarks:

1. The Panic Stops were conducted during the Road Trip.
2. Inspection following the completion of the Panic Stops revealed no additional movement of the payload.
3. Inspection following Passes #1 and #2 revealed that the tie-down rings and anchors on the EET performed adequately.

4. HAZARD COURSE:

Pass No.	Elapsed Time	Avg. Velocity (mph)
3	29 Seconds	5.2
4	30 Seconds	5.1

Figure 4.

Remarks:

1. Figure 4 lists the average speeds of the test load through the Hazard Course.
2. Inspection following the completion of the Passes #3 and #4 revealed no additional movement of the payload.
3. Inspection following Passes #3 and #4 revealed that the tie-down rings and anchors on the EET performed adequately.

5. WASHBOARD COURSE:

Remarks:

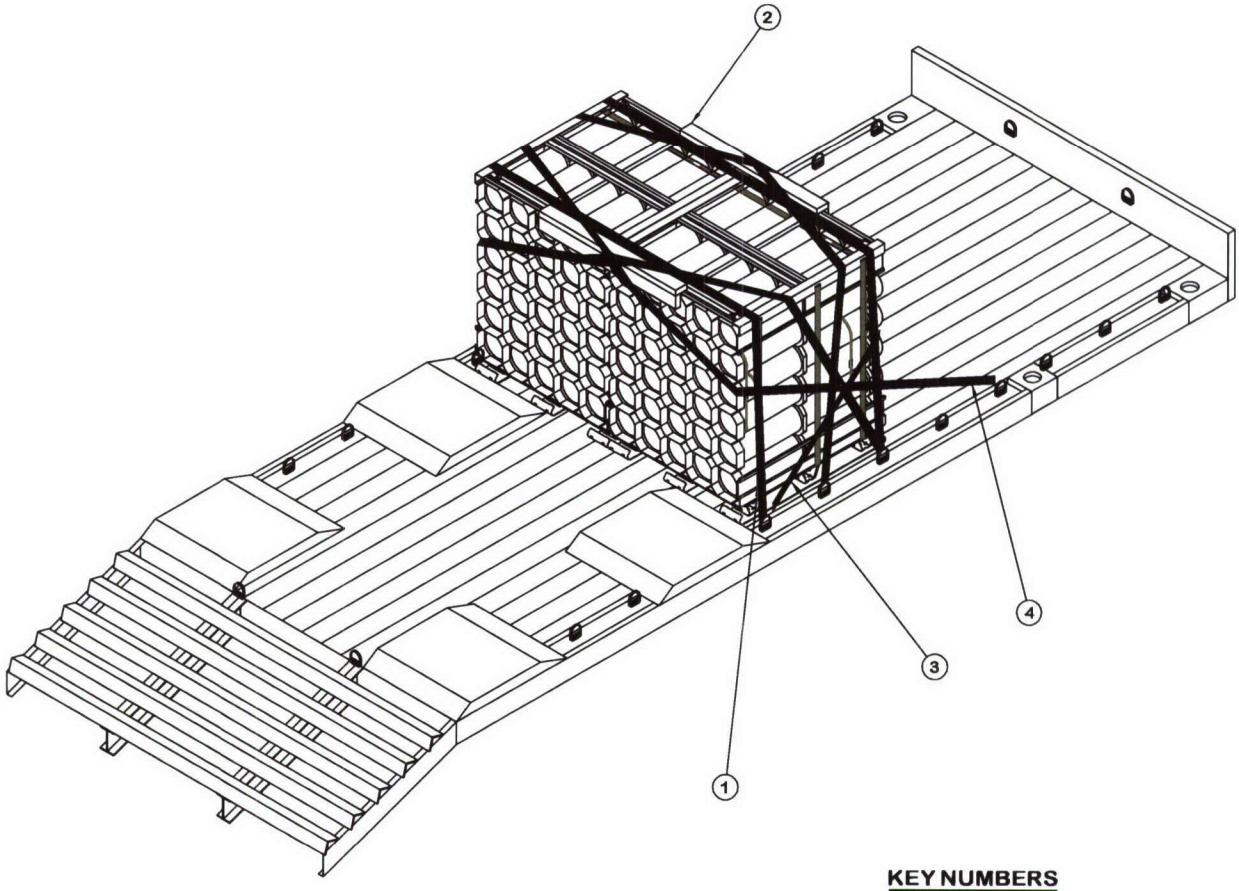
1. Inspection following completion of the Washboard Course revealed that the tie-down rings and anchors on the EET performed adequately.
2. Inspection following the completion of the Washboard Course revealed no additional movement of the payload.

Photo 4. Washboard Course Testing of the EET with 120MM Tank Ammunition

C. CONCLUSION: Throughout testing the tie-down rings and anchors on the EET performed adequately. The utilized test loads were effectively and efficiently secured using the tie-down provisions as designed. No damage occurred to the tie-down rings or anchors.

PART 6 – DRAWINGS

The following drawing represents the load configuration that was subjected to the test criteria.



ISOMETRIC VIEW

KEY NUMBERS

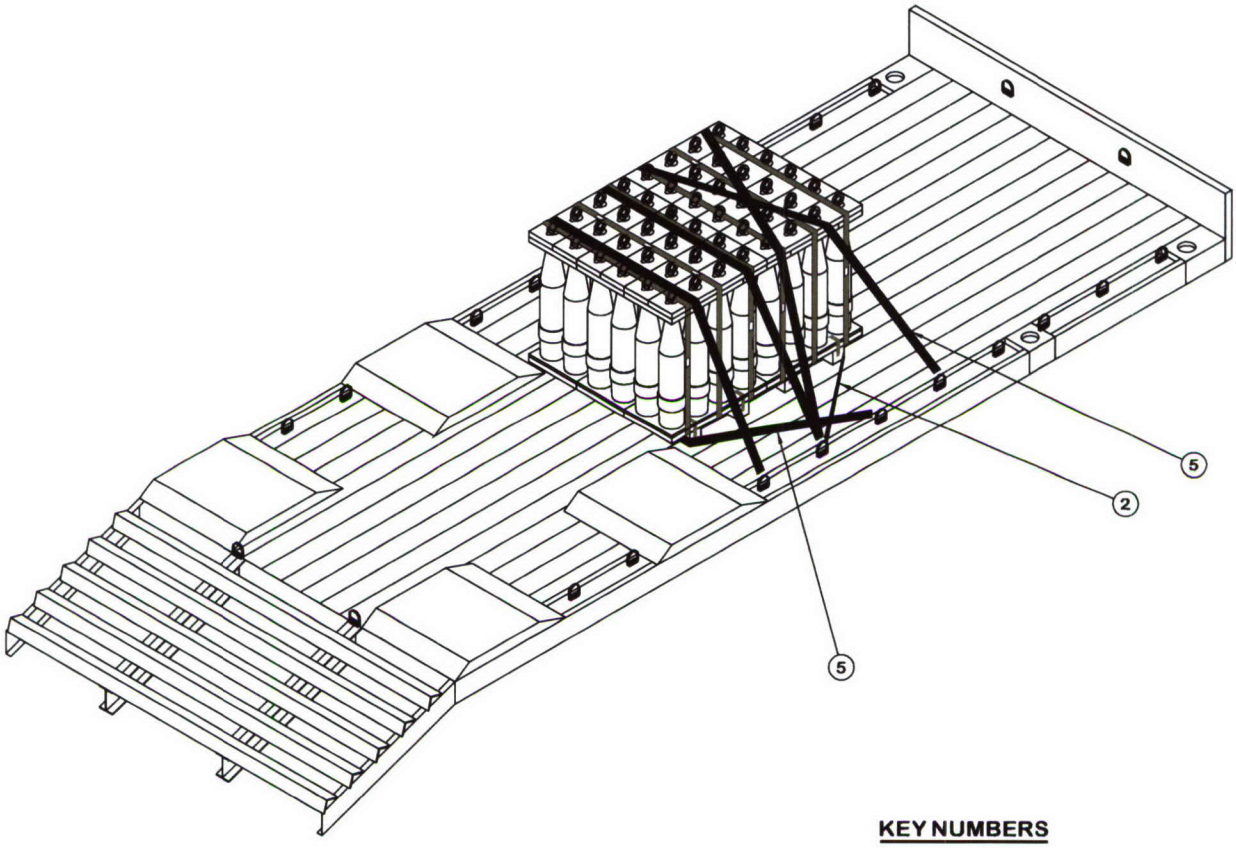
(1) WEB STRAP TIEDOWN ASSEMBLY (2 REQD). INSTALL THE STRAP TO EXTEND FROM A TIEDOWN ANCHOR ON ONE SIDE OF THE DECK, OVER THE PALLET UNITS TO A TIEDOWN ANCHOR ON THE OPPOSITE SIDE OF THE DECK.

(2) TOP EDGE PROTECTION ASSEMBLY, (2 REQD). POSITION ON TOP OF THE PALLET UNITS AT THE FRONT AND REAR OF THE LOAD AS SHOWN.

(3) WEB STRAP TIEDOWN ASSEMBLY (2 REQD). INSTALL THE STRAP TO EXTEND FROM THE EIGHTH TIEDOWN ANCHOR ON ONE SIDE OF THE DECK, AROUND THE FRONT OF A FORWARD PALLET UNIT, OVER THE FORWARD EDGE PROTECTOR AND DOWN TO THE SEVENTH TIEDOWN ANCHOR ON THE OPPOSITE SIDE OF THE DECK AS SHOWN.

(4) WEB STRAP TIEDOWN ASSEMBLY (2 REQD). INSTALL THE STRAP TO EXTEND FROM THE FOURTH TIEDOWN ANCHOR ON ONE SIDE OF THE DECK, OVER THE PALLET UNIT AND THE REAR EDGE PROTECTOR AND ACROSS THE BACK OF A REAR PALLET UNIT TO THE SIXTH TIEDOWN ANCHOR ON THE OPPOSITE SIDE OF THE DECK AS SHOWN.

120MM LOAD ON EET TRAILER



ISOMETRIC VIEW

KEY NUMBERS

(1) WEB STRAP TIEDOWN ASSEMBLY (2 REQD). INSTALL THE STRAP TO EXTEND FROM A TIEDOWN ANCHOR ON ONE SIDE OF THE DECK, OVER THE PALLET UNITS TO A TIEDOWN ANCHOR ON THE OPPOSITE SIDE OF THE DECK. NOTE: THERE SHALL BE A MINIMUM OF TWO STRAPS PASSING OVER THE TOP AND SECURING EACH GROUP OF PALLET UNITS ACROSS THE WIDTH OF THE LOAD.

(2) WEB STRAP TIEDOWN ASSEMBLY (2 REQD). INSTALL THE STRAP TO EXTEND FROM THE SEVENTH TIEDOWN ANCHOR ON ONE SIDE OF THE DECK, AROUND THE FRONT OF THE SKIDS ON THE FORWARD PALLET UNITS AND TO THE SEVENTH TIEDOWN ANCHOR ON THE OPPOSITE SIDE OF THE DECK AS SHOWN.

(3) WEB STRAP TIEDOWN ASSEMBLY (2 REQD). INSTALL THE STRAP TO EXTEND FROM THE SIXTH TIEDOWN ANCHOR ON ONE SIDE OF THE DECK, AROUND THE REAR OF THE SKIDS ON THE REAR PALLET UNITS AND TO THE SIXTH TIEDOWN ANCHOR ON THE OPPOSITE SIDE OF THE DECK AS SHOWN.

155MM LOAD ON EET TRAILER